Sustainment Metrics

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Overview

- **Sustainment Metrics History**
  - Why the metrics?
  - Metrics Background
  - Metrics Definitions
- **Metrics Usage**
  - DAES Assessments
  - Sustainment Quad Chart
  - Crosswalk Linkage
- **Sustainment Governance Update**

Why the Sustainment Metrics?

- **Warfighter demanded improved sustainment capabilities**
  - Joint Staff addressed warfighter need through the Sustainment KPP
  - Joint Staff revalidated requirement in the recent CJCSI 3170.01G
    - Changed Materiel Availability KPP to Availability, with two required KPPs, Materiel Availability & Operational Availability
- **Life Cycle Management as a policy or on implementation of a program cannot be achieved without metrics**
  - Both OSD and the Services need sustainment metrics to manage across the Life Cycle
  - Traditional acquisition metrics do not address sustainment issues
- **The four sustainment metrics bring a common set of parameters to manage across Services and platforms**
  - Previous performance metrics were not common and did not lend themselves to a portfolio style of management

Metrics Background

- **Sustainment Metrics established by Joint Staff 3170.01C in May 2007**
  - Materiel Availability (KPP)
  - Materiel Reliability (KSA)
  - Ownership Cost (KSA)
- **March 2007 memo by DUSD(A&T) required reporting of Life Cycle Sustainment as a fifth rating category in DAES submissions**
  - Rating is based on program's performance on the four sustainment metrics
  - Included Mean Down Time as the fourth metric
- **March 2007 memo by DUSD(L&MR) codified the metrics and required a reporting system to be established in DAMIR along with assessments in DAES**
- **July 2008 USD(AT&L) memo strengthened basis for Life Cycle Management priorities**
  - Directed L&MR & ARA to issue guidance on sustainment metrics reporting in DAMIR
  - In the interim all MDAPs were to establish metrics goals
  - Linked metrics reporting with other sustainment initiatives
- **December 2008 L&MR & ARA memo issues guidance on metrics reporting**
  - Requires reporting on the three JS sustainment metrics
  - Mean Down Time was left as optional
  - Reporting began March 2009
  - Linked to DAES ABC list for ease of use

Metrics Definitions

Materiel Availability

Input Directions: Materiel Availability is a number between 0 and 100 that provides the average percentage of time that the entire population of systems is materially capable for operational* use during a specified period.

- **Materiel Availability = $\frac{\text{Number of End Items Operational*}}{\text{Total Population of End Items**}}$**
- **Materiel Availability measures the percentage of the entire population that is operational.**

*** Operational means in a materiel condition such that the end item is capable of performing an identified mission.**

**** This does not include systems in long term or terminal storage.**

Materiel Reliability

Input Directions: Materiel Reliability = Mean Time Between Failure (MTBF)

Materiel Reliability = $\frac{\text{Total Operating Hours}}{\text{Total Number of Failures}}$

Ownership Cost (Being changed to Operating & Support Cost KSA in JCIDS Update)

Input Directions: Ownership Cost = Operations & Support (O&S) costs* associated with Materiel Readiness

*** Using the CAIG (CAPE) O&S Cost Estimating Structure Selected cost elements:**

- **2.0 Unit Operations (2.1.1 (only) Energy (Fuel, POL, Electricity))**
- **3.0 Maintenance (All)**
- **4.0 Sustaining Support (All except 4.1, System Specific Training)**
- **5.0 Continuing System Improvements (All)**

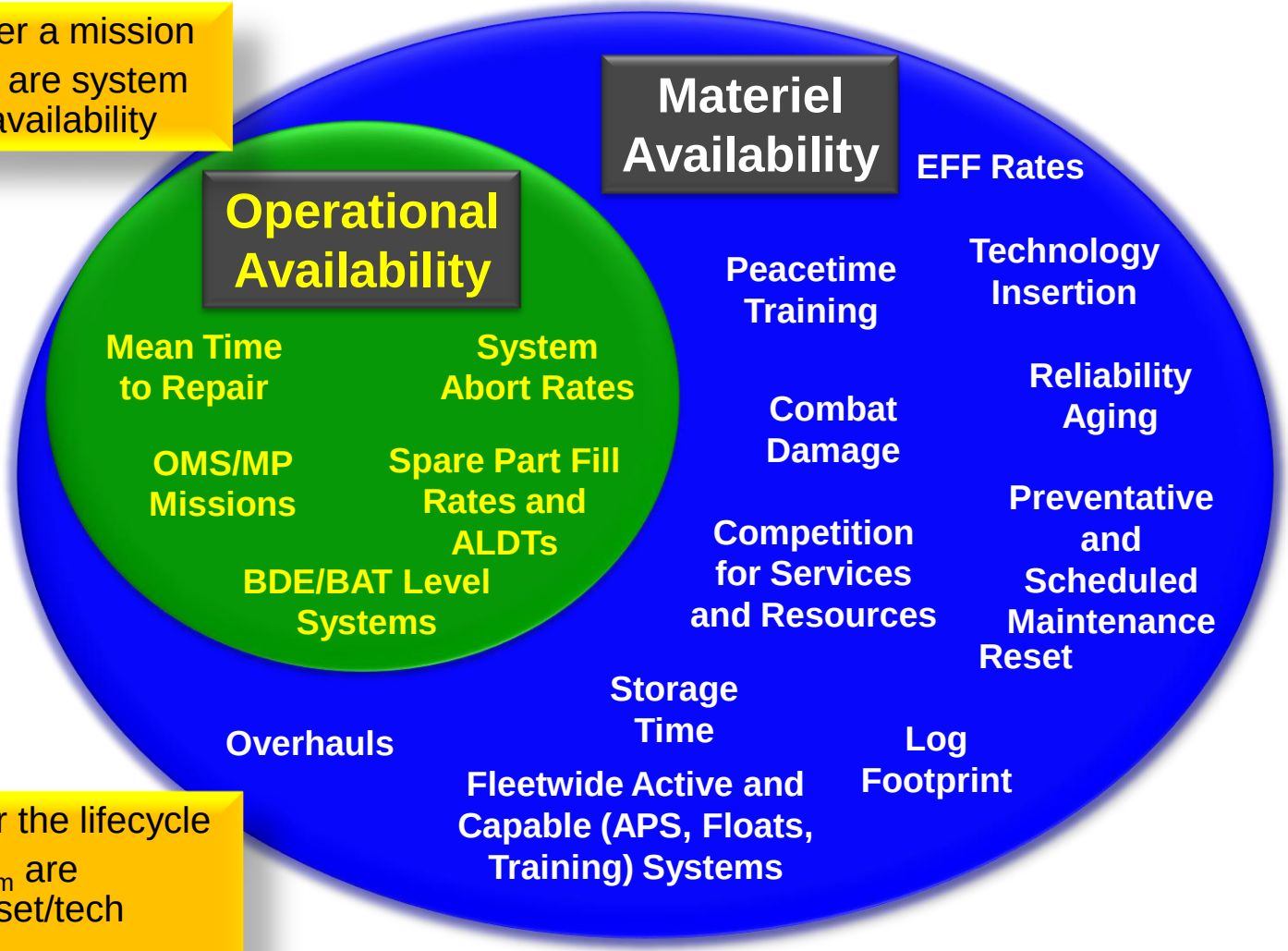
Programs should use the 2007 CAIG (CAPE) cost estimate definition.

Mean Down Time

Input Directions: Mean Down Time = $\frac{\text{Total Down Time for All Failures}}{\text{Total Number of Failures}}$

A_o versus A_m

- A_o: operational metric over a mission
- Largest contributors to A_o are system reliability and spare part availability



- A_m: fleetwide metric over the lifecycle
- Largest contributors to A_m are reliability and planned reset/tech insert downtime

Metrics Definitions Guidance

System Type	Example Systems	Materiel Availability	Use Measure(s)	Materiel Reliability	Annual Support Cost Tracking Measure
Ground Vehicles / Mobile Ground Systems	Abrams, ACV	Standard Method: Probability [0-1] (or percentage, 0% - 100%)	Operating Time	MTBF	Per System
Ships	DDG 51, LCS	The availability of the entire population of systems for tasking when the ship is not in a planned maintenance availability or unavailable due to material failure. This is expressed as a percentage	Operating Time	Mean Time Between Failure (MTBF) of a materiel failure to the ship. What constitutes a materiel failure is determined by class of ship	Per Ship/Boat
Aircraft	F-22A, KC-130J	Measure against fleet, aircraft Up/Down. Aircraft may be available even when some on-board systems are down.	Flight Hours	MFHBF (flight hours), or can use MTBF but *explain time accounting*	Per System
Single-Use Devices (Repairable)	AARGM, Patriot	Measure against total inventory, Uptime/ [Uptime + Downtime]. Item is Down after test (BIT) failure, Up after returned to fully capable status, e.g., In silo, ready for immediate use.	Trials (Missions attempted)	In-Flight Reliability, i.e., Probability of complete flight with no mission affecting failure, Probability (0-1 or percentage)	Entire Fleet
Single-Use Devices (Testable, Non-Repairable)	Excalibur, JDAM	In-storage/pre-flight reliability or mission success rate using total inventory	Trials (Missions attempted)	In-Flight Reliability	Entire Fleet
Special Case (Discrete Subsystems)	WIN-T	Standard Method	*Varies*	Convert to platform measure	Entire Fleet
Special Case (Electronic Boxes)	JTRS AMF	Standard Method	Time	MTBF	Entire Fleet
Special Case (Multiple Discrete Products)	JTRS HMS	(Can apply Standard Method for each discrete product)	*Varies*	Convert to platform measure	Entire Fleet
Satellites (Space Vehicle)	AEHF	Number of satellites on orbit with the capability to support mission operations	Time	Satellite segment mean time between critical failure	Complete Constellation
Satellites (Ground Segment & User Equipment)	NAVSTAR GPS User Equipment	Standard Method	Time	MTBF	All Systems

Metrics Example in DAMIR

F-22 / F-22						
Metric	Original Baseline Goal	Date	Current Baseline Goal	Date	Current Estimate/ Actual Data*	Description
Materiel Availability	60.0%	Jan-09	61.2%	Jan-10	57.1%	Aircraft Availability is the percentage of Mission Capable aircraft of the Total Aircraft Inventory. ACC operational requirement is 70.6%. Anticipate meeting the requirement in 2015. 62.1% is the current End of Year CY11 KPP requirement. (3rd Quarter FY11 thru 26 June 11 represents actual data)
Materiel Reliability	1.8 hrs	Apr-11	1.8 hrs	Apr-11	1.8 hrs	F-22As measure of Mean Time Between Critical Failure (MTBCF). MTBCF=Total Flight Hours/# Critical Failures ***Program estimate Current Actual - FY2011 actual data will be reported by AFOTEC after the completion of the FOT&E 3.
Ownership Cost	$46.9B	Sep-05	$46.9B	Sep-05	$46.9B	Ownership cost was calculated by totaling the specified cost elements from the CAIG O&S cost estimating structure across the aircraft lifecycle (2006-2033) for the fleet. The F-22 did not have an original baseline goal for ownership cost nor does it have a current approved baseline goal.
Mean Down Time	N/A	N/A	N/A	N/A	N/A	N/A

DAES Assessment Example

F-22A **Air Force**

PM Assessment: System projected to reach AA goal of 70.65% in 2015.

L&MR Synopsis: L&MR concurs with PM's assessment of yellow. Yellow rating based upon Materiel Availability goal of 61.2% was not achieved because low observable maintenance actions. The Air Forces fleet of F-22 super-jets stand down for the onboard oxygen systems was lifted on 21 September 2011

L&MR Assessment: L&MR assessment is "yellow". Materiel availability remained steady at 57.1% (current) against a current baseline goal of 61.2% based upon JROC approved change from Mean Time Between Maintenance (MTBM) KPP to Materiel Availability KPP. The program did not meet Materiel Availability because of the deterioration of low observable materiel and maintenance actions. FY12 Materiel Availability threshold is 62.6%.

The F-22 program achieved its current Materiel Reliability goal of 1.8 hours and Ownership Cost goal of $46.9B was achieved. The F-22 product support strategy was reviewed in preparation for the F-22 3.2B Modernization MDD DAB, which convened as a paper DAB on 4 October 2011. The program is developing a LCSP to support M/S B decision in 2013. There are no other known sustainment issues; therefore, based upon sustainment metrics performance, the program received an overall yellow sustainment rating.

L&MR Rating: Y

PM	G	G	G	Y	G
OSD	**G** AR&A/AM **Y** CAPE/CA				
PM	Y	G	G	G	G
OSD	**Y** L&MR				

Date: 16 Sep 11

F-22A Program

Product Support Strategy

Sustainment Approach

- Incr 3.2B sustainment managed as part of baseline F-22A
- Continue to meet availability and reliability cost objectives
- Reliability and Maintainability Maturation Program (RAMMP) in-place to reach aircraft availability goals
- CLS currently coves total system
- Component Avionics SORAs being processed for MS B, ICS until depot stand-up, IOC + 4 in future
- PBL transition to multiple year PBL, then multi-year PBL
- LCSP being developed for 3.2B

Issues: n/a

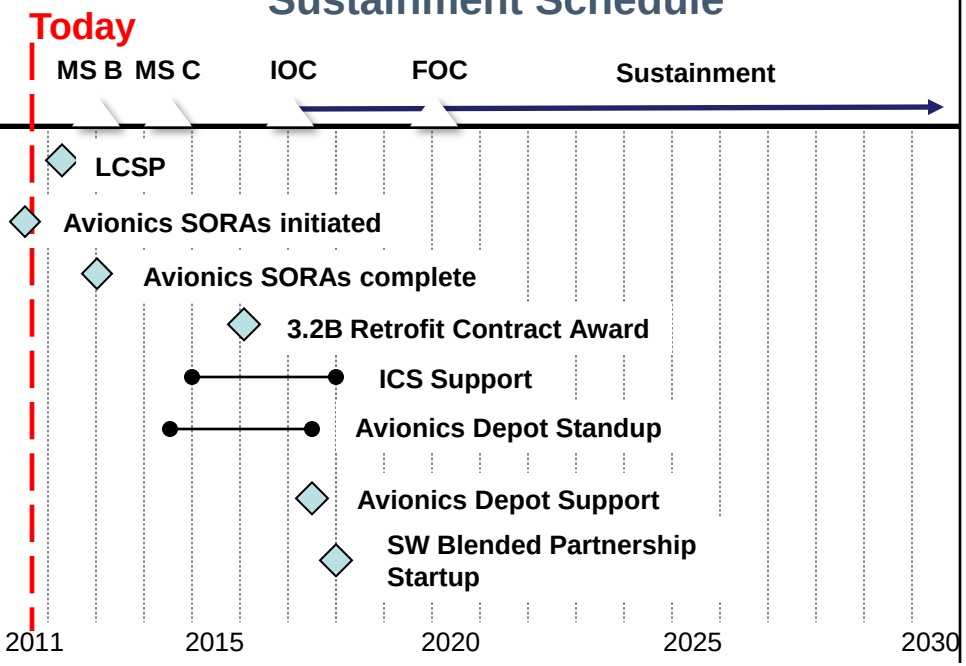
Resolution: n/a

Metrics Data

Metric	F-22A Baseline Goal	Current Estimate / Actual	Inc. 3.2B Original Goal	Inc. 3.2B Current Estimate
Materiel Availability	70.6%	57%	70.6%	70.6%
Materiel Reliability	1.8 hrs	1.8 hrs	1.8 hrs	1.8 hrs
Total O&S Cost (TY$)	$71.3B	$66.8B	$66.9B	$66.9B
Mean Down Time	n/a	n/a	n/a	n/a

Sources: F-22 Life Cycle Sustainment Metrics Report, June 2011; F-22 POE FY09, F-22 POE FY11. Notes: (1) F-22 baseline material availability goal is for FY15 ; goal for FY11 is 61.2%. (2) Inc. 3.2B includes F-22A baseline.

Sustainment Schedule



O&S Data

Cost Element	F-22A Current Estimate	F-22A Current Actual Cost	Inc 3.2B Original Baseline	Inc 3.2B Current Estimate
1.0 Unit-Level Manpower	2.30	2.21	2.30	2.30
2.0 Unit Operations	0.90	1.10	0.90	0.90
3.0 Maintenance	4.56	4.59	4.60	4.60
4.0 Sustaining Support	1.84	0.05	1.84	1.84
5.0 Cont.Sys. Improvements	0.37	0.50	0.37	0.37
6.0 Indirect Support	1.35	0.36	1.35	1.35
Total	**$11.32**	**$8.80**	**$11.35**	**$11.35**

Note: annual cost per aircraft in BY05$M; estimates are for FY22, actual is for FY10

Total O&S Costs	F-22A Current Estimate	Inc 3.2B Original	Inc 3.2B Current
Base Year 05 $B	$46.207B	$46.292B	$46.292B
Then Year $B	$66.753B	$66.881B	$66.881B

F-22A Increment 3.2B Program, Milestone A - O&M and O&S Crosswalk Chart

Program Funding & Quantities (O&M) vs. Sustainment Quad (O&S)

	Program Funding & Quantities Chart	Sustainment Quad Chart
Purpose of Chart	**Assess O&M Affordability**	**Assess O&S Cost**
Terms of Reference	**Weapon System Total O&M (TY $M)**	**Total O&S Cost (TY $M)**
Quantity of Assets Included in the Analysis[/1]	184[/2]	184[/2]
Unit Level Manpower (OSD CAPE Element: 1.0)[/3]		14,737M
Unit Operations - Energy (2.0)	5,337M	5,337M
Unit Operations - Support Services; TAD/TDY (2.0)		1,992M
Maintenance (3.0)	24,346M	24,346M
Sustaining Support (4.0)	10,160M	10,160M
Sustaining Support - System Specific Training (4.0)		1,112M
Continuing System Improvements - SW Maint (5.0)	1,074M [/4]	1,074M
Continuing System Improvements - Mods (5.0)		878M
Indirect Support (6.0)	7,244M	7,244M
Total Cost	**$48,426M**	**$66,881M** [/4]

Notes:

1. Estimate is for F-22A operational lifecycle, FY06-FY33 (28 years). Increment 3.2B operational lifecycle is expected to be 16 years , FY18-FY33.
2. 184 is the number of aircraft included in the F-22A O&S Program Office Estimate. Increment 3.2B will be installed on 143 aircraft.
3. Uses 2007 CAPE cost estimating structure.
4. O&S and O&M costs include costs for both the F-22A baseline and the Increment 3.2B program. 3.2B adds $128M to total F-22A O&S costs, all of which are O&M funds: $6M for energy and $122M for maintenance. Total estimated O&S cost for the F-22A Baseline, omitting Increment 3.2B, is $66,753M.

Sustainment Governance Update

- **L&MR has submitted governance guidance in a new DAES Policy Memo**
- **Several different areas of sustainment reporting are addressed in the memo:**
  - Clarifies reporting requirements on the sustainment metrics.
  - Guidance for the sustainment quad chart is updated.
  - Provides instruction on the use and creation of the O&M/O&S Crosswalk chart.
  - Directs reporting changes to reflect switch from Ownership Cost KSA to the O&S KSA
  - Directs a way forward for the Services and OSD on starting to report legacy program sustainment metrics.

Questions

Backup Slides

CH-47F Sustainment

Product Support Strategy

Sustainment Approach

- Current – Transitioned from ICS for F model unique parts to Army Supply System; working 8UE NET
- Future – Working depot/industry partnership for CAAS components; PBL for blades; cross-service PBL for APU

Issues

- Lack of low demand F model structure for CBD aircraft
- High number of engines returned from theater to depot

Resolution

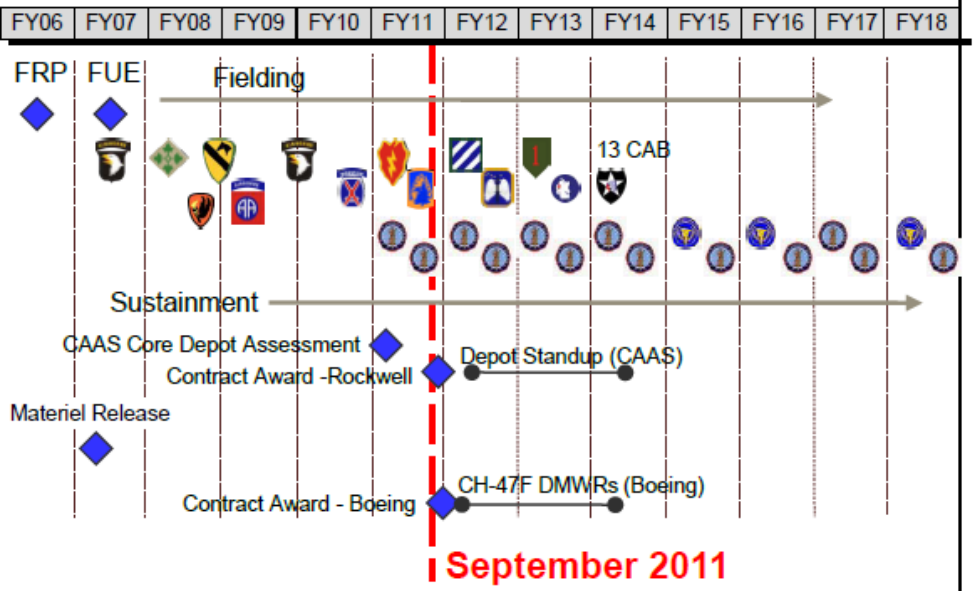
- Purchasing long-lead structure for inventory
- Running removed engines on FED stand in Kuwait to repair forward if possible (30% AVIM level work)

Metrics Data

Metric	CH-47D Actual	CH-47F Original Goal	CH-47F Goal	CH-47F Current Estimate
Materiel Availability	64%	N/A	70%	73%
Materiel Reliability	N/A	3.3 hrs	3.3 hrs	4.6 hrs
Ownership Cost	10.1B	14.4B	14.4B	13.6B

1. Material Availability Goal: Total requirement X .80/Total Procurement
2. Material Availability Current: Aircraft Fielded X MC%/Total Aircraft Fielded
3. Reliability reported as Mean Time Between Essential Maintenance Action.
4. Ownership Cost based on CAIG element structure mapped to POE.

Sustainment Schedule



O&S Data

Cost Element	CH-47D Cost	CH-47F Orig Baseline	CH-47F Current Cost
1.0 Unit-Level Manpower	549.0	358.8	353.9
2.0 Unit Operations	836.7	939.1	911.3
3.0 Maintenance	276.8	336.9	360.0
4.0 Sustaining Support	43.8	40.5	39.8
5.0 Continuing System Improvements	71	55.4	55.6
6.0 Indirect Support	144.4	136.6	138.7
Total	1921.7	1867.3	1859.3

Avg. annual per aircraft in BY2005$K; SAR CH47D est. not used: will correct in next SAR. Source: CH47D:POE (422 a/c) CH47F baseline: FRP ACP (434) CH-47F current: POE (440 a/c).

Total O&S Costs	CH-47D	CH-47F
Base Year 2005 $M	16219.2	16361.8
Then Year $M	16694.7	22208.9

Life Cycle Sustainment

Date: 21 SEP 2011

Product Support Approach

Sustainment Approach

- Existing support infrastructure for legacy equipment
- Interim Support Period PBL contracts for new equipment

Issues

- Ensuring shore maintenance & training supports small crew
- Training crew to be Ready For Qualification
- Align Budget Controls for maintenance, spares, shore support, training, and software sustainment

Resolution

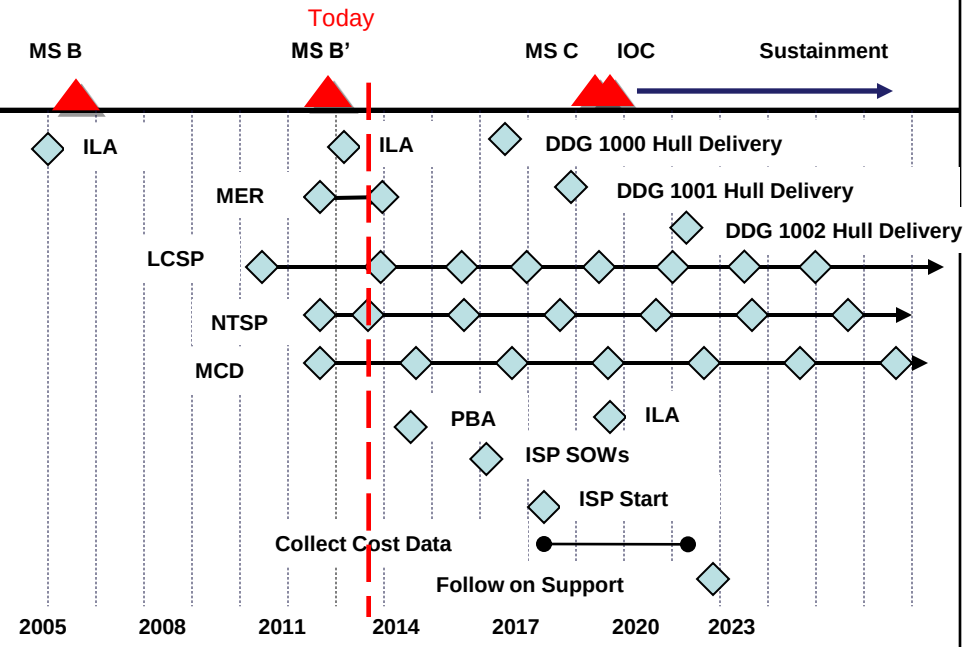
- Robust HSI program, analysis of crew and shore workload
- Close coordination with NPC, N1, N86 for NTSP
- Coordination with Fleet and N1, N4, N6, and N86 for establishing FYDP based on upcoming revised O&S Estimate

Metrics Data

Metric	Antecedent Actual	Original Goal	Current Goal	Current Estimate/ Actual
Materiel Availability	N/A	80.2%	80.2%	80.2%
Materiel Reliability	N/A	3888 hrs	3888 hrs	3896 hrs
Ownership Cost	N/A	$44.1B (FY10$)	$9.23B (FY10$)	$9.23B (FY10$)
Mean Down Time	N/A	N/A	N/A	N/A

Notes: DDG 1000 SAR does not identify antecedent system. Materiel Reliability based upon Ao modeling of mission critical combat systems against 180 day deployment. Original Ownership Cost Goal was based on 24 ships vs. current 3.

Sustainment Schedule



O&S Data ($M)

Cost Element	Antecedent Cost	DDG 1000 Baseline	DDG 1000 Current Cost
1.0 Unit-Level Manpower	N/A	11.6	11.6
2.0 Unit Operations	N/A	13.8	13.8
3.0 Maintenance	N/A	22.3	22.3
4.0 Sustaining Support	N/A	2.3	2.3
5.0 Continuing System Improvements	N/A	31.8	31.8
6.0 Indirect Support	N/A	6.1	6.1
Total	**N/A**	**87.9**	**87.9**

Notes: Baseline re-established during MS B recertification in 2010.

Total O&S Costs	DDG 1000
Base Year $M	$9.23B (FY10)
Then Year $M	$9.43B

O&S Baseline data is from July 2010 PLCCE supporting MS B recertification. Disposal costs not included.

AARGM Sustainment

Product Support Strategy

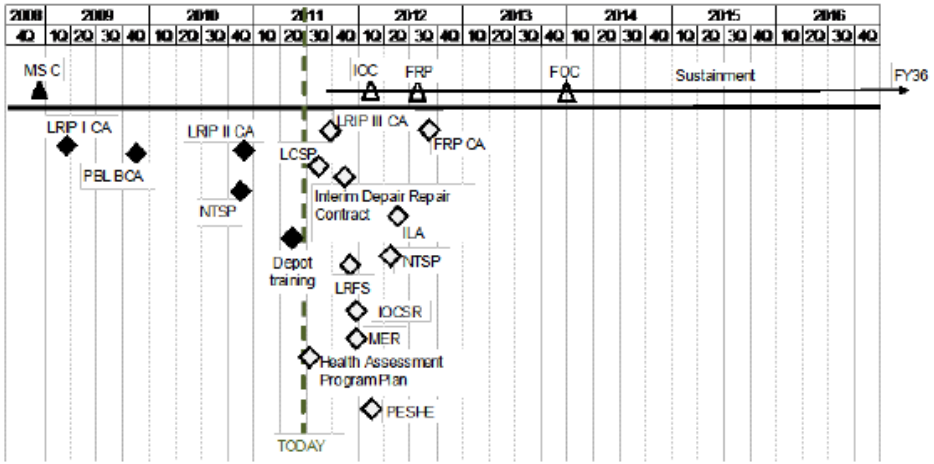
- Sustainment Approach
  - AARGM provides three existing levels consistent with HARM (O, I and D)
  - Intend to initiate interim depot repair with OEM 3rd Quarter FY2011 using Basic Ordering Agreement (BOA) vehicle
  - Long term depot plan is in development

Metrics Data

Metric	Antecedent Actual	Original Goal	Current Goal	Current Estimate/ Actual
Materiel Availability	90%	90%	90%	97%
Materiel Reliability	28 Hrs (MTBF)	28 Hrs (MTBF)	28 Hrs (MTBF)	24.3 Hrs* (MTBF)
Ownership Cost (BY$03)	1.474B	1.424B	1.750B	1.8B
Mean Down Time	N/A	N/A	N/A	N/A

*Data gathered 2007 (start of DT) to 21 Mar 10; hardware (MHFBF) = 48.6 hrs

Sustainment Schedule



- Schedule reflects current IOC estimate
- Current APB approved IOC threshold is May 2011
- Developing PDR and revised APB

O&S Data (BY$03)

Cost Element	Antecedent Cost	[Program] Orig Baseline	[Program] Current Cost
1.0 Unit-Level Manpower	0.122	2.540	2.540
2.0 Unit Operations	0.592	1.812	1.812
3.0 Maintenance	0.878	4.439	4.439
4.0 Sustaining Support	1.489	3.094	3.094
5.0 Continuing System Improvements	1.147	2.640	2.640
6.0 Indirect Support	0.014	0.234	0.234
TOTAL	**4.242**	**14.759**	**14.759**

Total missile costs are calculated by multiplying the average annual cost for all missiles by the weapon service life of 15 years vice 20 years for the antecedent.

Total O&S Costs	Antecedent	[Program]
Base Year $M	84.3	221.4
Then Year $M	129.7	382.3